UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
WASHINGTON, DC 20555-0001

January 15, 2003

NRC INFORMATION NOTICE 2003-01: FAILURE OF A BOILING WATER REACTOR TARGET ROCK MAIN STEAM SAFETY/RELIEF VALVE

Addressees

All holders of operating licenses or construction permits for nuclear power reactors, except those that have permanently ceased operations and have certified that fuel has been permanently removed from the reactor.

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice to alert addressees to a recent failure of a main steam safety/relief valve on a boiling water reactor (BWR). The NRC anticipates that recipients will review the information for applicability to their facilities and consider taking appropriate actions. However, suggestions contained in this information notice are not NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances

In April 2002, following a Unit 1 refueling outage at the Hatch Nuclear Plant, the safety/relief valve (S/RV) in the 1J location began leaking. In an effort to stop the assumed pilot valve leakage, the licensee cycled the S/RV at rated pressure and temperature. The valve failed to fully open and then failed to reseat. The licensee continued the startup to allow identification of potential balance-of-plant leakage. During the balance-of-plant startup, the associated S/RV vacuum breaker failed due to repeated cycling**,** resulting in high unidentified drywell leakage. The plant was shut down when the leakage exceeded the technical specification allowable leakage (reference LER 50-321/2002-002).

The S/RVs installed in Unit 1 are Target Rock two-stage S/RVs. The main stage valve internals (shown in attached Figure 1) are assembled by screwing the main piston onto the main stem so that the piston moves inside the guide, installing a locking tab washer, and installing the stem nut against the washer's locking tab. The piston is torqued to 100 ft-lbs, the stem nut is torqued to 50 ft-lbs, and the locking tab is bent to capture the stem nut. During the S/RV inspection after the April 2002 shutdown, the failed valve was found to have a .003-inch clearance between the main disc and its seat. When the valve was disassembled, the stem nut and the

piston were found to be loose. The stem nut was removed by hand and the piston was also unthreaded by hand from the stem. However, the threads on the stem were severely damaged. The piston was unthreaded by working it up to the good threads under the stem nut and threading it onto this portion of the stem. The inside of the guide was heavily grooved and was also worn by the piston edge wearing on the guide. The piston was visibly cocked on the valve stem.

In an earlier event in 1999, the licensee had a different S/RV fail on the test stand. This failure occurred during the fourth valve actuation when the stem nut fell off the stem and jammed in the preload spring coils. The resulting uneven force caused the piston to cock in the guide. The stem nut had lost torque and came unscrewed from the stem threads in spite of the locking tab. Following this failure, the licensee instituted a program to check the torque on both the stem nut and the piston. The licensee found in most cases, both the stem nut and the piston had lost torque.

Following the failure of the 1J S/RV, the licensee closely examined three valves which had been removed during the April 2002 refueling outage. The stem nuts and pistons of all three valves had lost torque, the stems of two of the valves showed significant wear on the valve threads, and one valve exhibited some thread wear. All three valves showed signs of damage on the stem shoulder, which is designed to contact the piston. In October 2002, the licensee removed three additional S/RVs from Unit 1 for testing, disassembly, and inspection. All three valves successfully stroked with steam pressure but when disassembled and inspected, were found to have lost torque on both the stem nut and the piston. Two valves had fairly good threads and the final valve (1F) had significant thread damage and a visibly cocked piston. All three valve stems showed varying degrees of damage in the shoulder area.

The licensee believes the loss of torque and damage of the valve internals can be attributed to the manufacturing tolerances of the valve stem and piston and to the lengthy service time without adequate inspection and maintenance. The valve is designed so the valve stem screws into the piston. The stem has a shoulder that seats against the piston shoulder. For the valves that show little to no thread damage, the stem apparently seats properly against the piston and most of the valve actuation force is carried by the stem and piston shoulders. For the valves with thread damage, the licensee believes that the end of the lead thread of the piston contacts the fillet that is machined into the shoulder of the valve stem. As shown in Figure 1, when this occurs, the shoulder of the stem does not properly seat against the shoulder of the piston. Thread damage starts with the first actuation on the test stand, resulting in a loss of torque. Over time, vibration from normal plant operations causes fretting and wear of the valve stem shoulder and threads. The piston rocks in the guide and wears grooves where the piston rings contact the guide. Eventually the piston could significantly cock on the stem and wedge in the guide during valve actuation, which would prevent proper opening or closing of the valve. The licensee has not been able to determine the time in operation required to damage a valve to the point of failure. The licensee believes the failed 1J valve and the damaged 1F valve were in service for approximately 20 years without maintenance. The licensee is currently removing several S/RVs during each plant outage to ensure that all installed S/RVs are inspected and maintained at least every 6 years. There are 11 S/RVs installed in each unit.

Discussion

As the result of the 1J valve failure, the licensee performed a root cause analysis following the event and contracted an independent engineering firm to perform a separate root cause analysis. The licensee believes that the failure of the S/RV is related to the manufacturing tolerances of the valve stem and piston assembly and to the lengthy service time without adequate inspection and maintenance. The independent root cause analysis determined that the lead thread of the piston was contacting the fillet of the shoulder, preventing shoulder-to-shoulder contact. Since the piston was not adequately attached to the stem, operational vibration and valve actuation caused thread damage and eventual valve failure. The valve vendor (Curtiss Wright Flow Control Corporation) has developed changes to the inspection and refurbishment procedures to ensure proper shoulder-to-shoulder contact during valve assembly. The BWR vendor (GE Nuclear Energy) is issuing a Service Information Letter (SIL) to address the degradation found in the Hatch S/RVs.

The above-described circumstances emphasize the importance of periodic inspection of S/RV main stage components to identify deficiencies and necessary corrective actions. All Target Rock two-stage and three-stage S/RVs have similarly designed main stage components. Currently 11 BWR plants in the U.S. have two-stage S/RVs, and 11 BWR plants have three-stage S/RVs.

The above described problems found in the main stages of Target Rock S/RVs are not related to the problems found previously in the pilot stages of the S/RVs that were discussed in Regulatory Issue Summary 2000-12, “Resolution of Generic Safety Issue B-55.”

This information notice requires no specific action or written response. If you have any questions about the information in this notice, please contact one of the technical contacts listed below or the appropriate Office of Nuclear Reactor Regulation (NRR) project manager.

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Attachments: 1. Figure 1 - Target Rock Safety/Relief Valve
2. List of Recently Issued NRC Information Notices

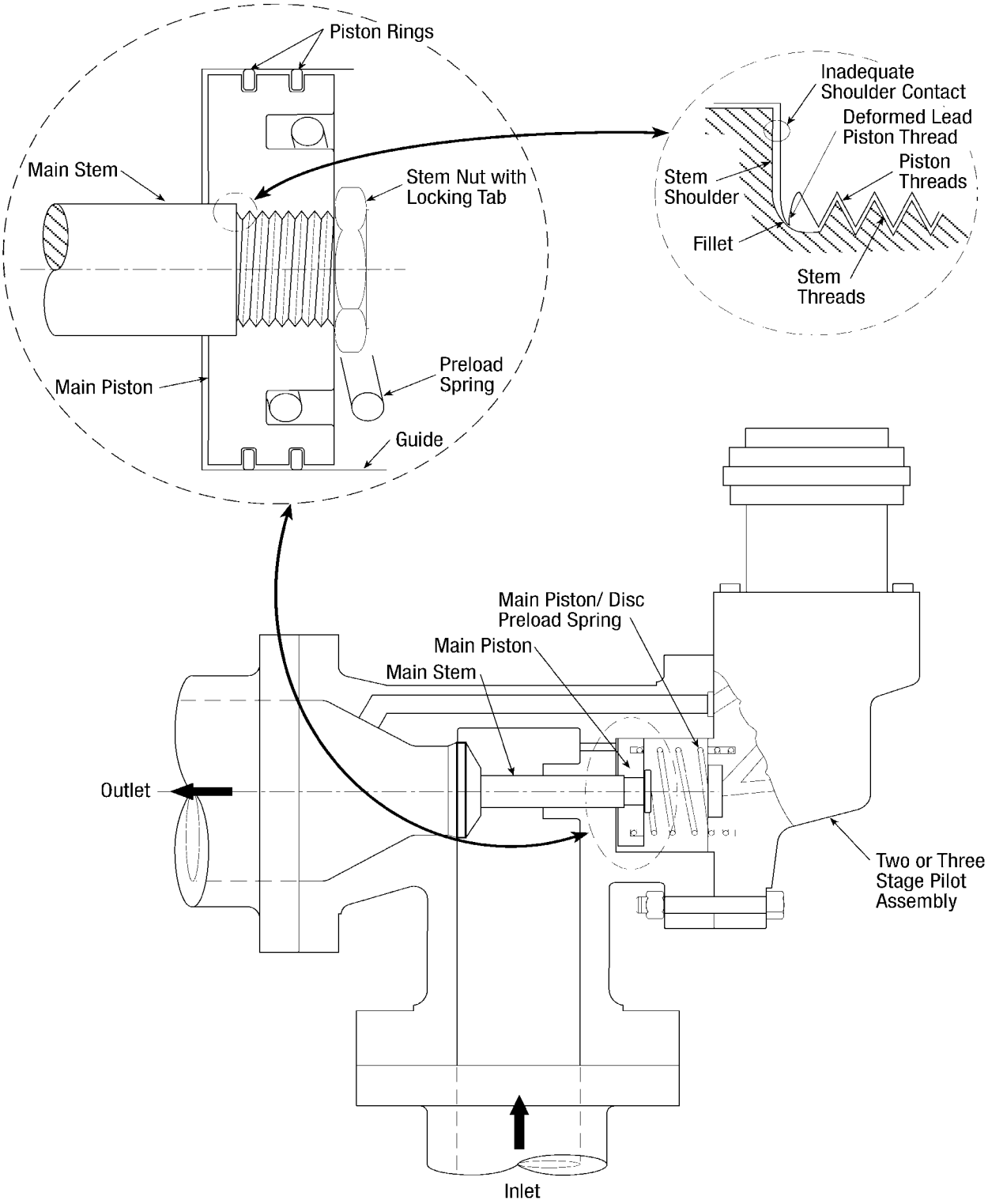

Figure 1 Target Rock Safety/Relief Valve